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ABSTRACT

The degree of success of the computerized Child-Based Information System (CBIS) was analyzed in two areas--presenting, delivering, and managing a developmental curriculum; and recording, filing, and monitoring child tracking data, including requirements for Individualized Education Plans (IEP's). Preschool handicapped and high-risk children and their mothers participated in a home-based tutoring program, and the developmental growth of the children was measured with the Peabody Picture Vocabulary Test (PPVT), the Boehm Test of Basic Concepts (BTBC), and the Memphis Comprehensive Developmental Scale (MCDS), while the Maternal Teaching Style Research Instrument (MTSRI) was used to compare mothers and their behavior prior to and following home intervention. Analysis of data from the group using the computerized management information system and two control groups using part or none of it showed that CBIS not only led to better identification of relevant objectives for individual children and to their increased achievement, but reduced administrative costs. CBIS appears to exceed the mandate of recent federal legislation (P.L. 94-142) requiring appropriate and individualized instruction for the exceptional child. (JD)

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AN ANALYSIS OF A COMPUTERIZED SYSTEM FOR MANAGING CURRICULUM DECISIONS AND TRACKING STUDENT PROGRESS IN A HOME-BASED PRE-SCHOOL EDUCATION PROJECT

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AN ANALYSIS OF A COMPUTERIZED SYSTEM FOR MANAGING CURRICULUM DECISIONS AND TRACKING STUDENT PROGRESS IN A HOME-BASED PRE-SCHOOL EDUCATION PROJECT

The Child-Based Information System (CBIS) was designed as a guideline for instruction and a system for recording student progress and maintaining permanent records. The Central Susquehanna Intermediate Unit (CSIU) has supported development of this computerized management information system in response to the movement of the seventies toward appropriate and individualized instruction for the exceptional child.

This study was designed to analyze the degree of success of a computerized child-based information system. More specifically, it was planned to investigate the relative success of a computer in presenting, delivering, and managing a child-referenced developmental curriculum within the framework of recent federal legislation (P.L. 94-142).

Program

The CSIU's preschool program for handicapped and high-risk children has, as its primary function, the identification of eligible preschool children. It refers children to existing programs designed to meet their specific needs and has its own intervention program designed to remediate weaknesses in perceptual and cognitive abilities through home tutoring which also provides parent training (Abrams and Pieper, 1968; Kagan, 1969, 1971; Lopate, Flaxman, Bynum, and Gordon, 1970; Heber, 1972; Taylor, 1976).

Under Public Law 94-142, state agencies and school districts are required to guarantee public education for the individual handicapped child, at no cost to his parents or guardians, and to locate, identify, and evaluate all handicapped children requiring special education. In addition, written individualized education programs (IEP's), designed specifically for each handicapped child, must be developed jointly with a parent or guardian, and, if possible, with the handicapped child himself or herself.

The requirements for an intervention program and planning for individualized instruction and administrative data collection were planned four years ago to be fulfilled through a child-oriented, rather than an administratively-oriented system. The system was designed to assign educational programs for individual children, store achievement data, review child progress every 45 days, and issue progress reports. In addition, it was designed to process administrative data forms, establish and monitor time lines, and generally serve as an administrative information management system (Guthrie, 1977).

CBIS includes several components, including a student data base, a curriculum base with the mechanics for tracking student progress, and an instructional strategy bank. The student data base includes the basic information about individual students necessary for efficient and comprehensive record-keeping; the curriculum base consists of several strands of sequentially developed instructional objectives; and the instructional strategy bank includes computer-stored instructional strategies which have been designed and evaluated by classroom teachers.

Method

Design

A pretest-posttest control group design was selected for this study in order to control for major threats to internal validity. Participating tutors and children were selected for three study groups. The differences in activities between the three groups were primarily differences in the use of the computer for the management of required information (used in Group A; not used in Groups B and C), and the developmental approach to the curriculum (designed according to chronological age in Groups A and B; according to tutor experience in Group C). The independent variables thus included the use of the computer and the developmental basis of the curriculum.

Measures were used to assess children's educational progress and mother-child interaction. Cost information related to tutor and staff time for managing data for IEP's was also collected. The dependent variables were child progress, maternal interaction, and data management cost.

Study Sample

a) Tutors. Fifteen tutors from the pre-school program were selected to participate in the study. They were selected and matched on the basis of age, previous program experience, previous school-based teaching experience, maternal experience, and county of residence. The tutors were grouped into triplets on the basis of the closest match of these characteristics. Each tutor from the triplets thus homogeneously grouped was randomly assigned to one of the study groups.

b) Children. Children participating in the study included a sample from the child population base involved in the 1976-77 pre-school program, which included high-risk and handicapped children, aged 3 to 5 years. In order to maintain program integrity, random assignment of children to tutors was not possible--children were assigned to tutors on the basis of geographic location. A total number of 80 children participated in the study.

c) Parents. The parents participating in the program were mothers of the participating children. The pre-school program includes a home-tutoring program which provides primary service to high-risk and handicapped preschool children; a fundamental component of the program is training for mothers of these target children.

Procedures

The goal for each of the three study groups was the same; that is, to stimulate the developmental growth of high risk and handicapped preschool children so that upon enrolling in elementary school, the abilities, aptitudes, and achievement levels might be more consistent with the norms for their age.

Each of the three groups was involved in a developmental curriculum. The computer-based curriculum was developed from norm-referenced behavioral expectations for children, aged from birth through five years. The control curriculum was designed according to previous program experience where tutors planned activities that would help children achieve certain basic concepts identified by the Boehm Test of Basic Concepts.

Group A used the behavioral curriculum through the computer and also stored records and child tracking information for IEP's by computer. Group B used the

same behavioral curriculum from paper copy and sent IEP records and tracking information to the office staff for computer storage. Group C used the conceptually-oriented curriculum from paper copy and also sent IEP records and tracking information to the office staff.

IEP's were prepared for each child in the preschool program following the same format, information requirements, and content. However, IEP's were prepared with the assistance of the computer for Groups A and B, but with staff assistance for Group C.

All tutors participated in a week-long inservice training session at the beginning of the school year. Content and training activities were largely identical for all tutors for three days. During this time, training was provided on organizational regulations, program overview, and speech and language development training.

The additional two days provided differentiated training based upon curriculum use and record keeping according to the needs of the separate study groups. Group A tutors received training in the total computerized CBIS curriculum and child tracking system; Group B tutors were trained for paper copies of the CBIS curriculum and record-keeping requirements coordinated through the office staff; Group C tutors received training in the conceptually-oriented curriculum and the record-keeping requirements coordinated through the program office.

Throughout the study, CSIU staff monitored the integrity and documented the consistency of planned activities. These activities are summarized in Table 1.

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INSERT TABLE 1 ABOUT HERE.

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Measures Used

a) Peabody Picture Vocabulary Test (PPVT). This test was developed "to provide an estimate of a subject's verbal intelligence through measuring his hearing vocabulary" (Dunn, 1965). Results are used to estimate the mental ages and intelligence quotients of non-readers.

b) Boehm Test of Basic Concepts (BTBC). This instrument was designed "to measure children's mastery of concepts considered necessary for achievement in the first years of school" (Boehm, 1971). Results can help identify children with deficiencies in conceptual attainment as well as help identify concepts for instructional emphasis.

c) Memphis Comprehensive Developmental Scale (MCDS). This scale was designed to determine the current developmental skill functioning of children within the identified skill areas of personal-social, gross motor, fine motor, language, and perceptual-cognitive (Memphis State University, 1974). Results can help identify which of the defined skill areas a child is able to demonstrate and can provide rough estimates of a child's developmental levels and needed instructional emphases.

d) Maternal Teaching Style Research Instrument (MTSRI). This instrument was developed to determine mother-child relationship factors on an observable behavioral basis (Levin and Henderson, 1974). Results are based on observations of the mother's interaction with her child on a standard series of tasks and allow for comparison of mothers and mothers' behaviors prior to and following home intervention.

Data Analysis

The dependent variables of child progress and maternal interaction were examined in several ways. The PPVT, BTBC, and MCDS were analyzed by analysis of covariance (ANCOVA). The criterion measure for each analysis was the posttest score of each instrument; the control measures were the number of tutoring sessions conducted and an allometric score of the PPVT and BTBC pretest scores (Lutz, 1970). (Pretest scores on the MCDS were not used in calculating allometric pretest scores due to the lack of reliability and validity data for this instrument.) Data from the MTSRI were also analyzed by ANCOVA, using the MTSRI posttest score as the criterion measure and the number of tutoring sessions and the MTSRI pretest score as control measures.

The dependent variable of the average cost per student for completing progress reports on children (Groups A and B) was analyzed using analysis of variance (ANOVA). Similarily, the average tutor planning time per session (Groups A, B, and C) was also analyzed with ANOVA.

Finally, an analysis of age and sex characteristics of participating children was completed using ANOVA for comparing mean ages between groups, and the χ^2 test for comparing the distribution of sex among the three groups.

The Newman-Keuls sequential multiple comparison procedure was selected to test for observable differences between group means pending the outcomes of the ANOVA and ANCOVA (Lutz, 1970). If the ANOVA or ANCOVA identified significant differences, then the Newman-Keuls procedure was used to specify which group mean was significantly different from the others.

Results

Tables 2 - 4 summarize the data from the analyses of covariance for child progress. There was no significant difference in performance on the PPVT or the MCDS when the data was statistically controlled for the number of tutoring sessions and the allometric score representing the child's enetering level (Tables 2 and 4). Table 3, however, shows a significant difference in BTBC scores ($p < .05$) between the three groups. Differences between means were analyzed with the Newman-Keuls procedure which determined that the BTBC scores for children in Group A were significantly higher than the scores for children in the other two groups.

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INSERT TABLES 2, 3, AND 4 ABOUT HERE.

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The analysis of maternal interaction has been summarized in Table 5; there was a significant difference in MTSRI scores ($p < .05$) between groups when the analysis controlled for the number of tutoring sessions and the MTSRI pretest score. Further investigation (Newman-Keuls) showed that there were significant differences between the mean scores for all groups. Maternal interaction, as represented by a score on the MTSRI, was highest for mothers in Group A and lowest for mothers in Group B.

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INSERT TABLE 5 ABOUT HERE.

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Data management cost information has been summarized in Tables 6 and 7. There were no significant differences in the average planning time for the tutoring sessions as reported by the tutors in each group (Table 7). However, the average cost for completing required student reports for IEP's was significantly cheaper when managed directly by the tutors when compared to sending information to the office staff for management. The tutor data management cost was $1.80 per student, while the office data management cost was $2.92 per student. The record keeping activities of Group C tutors was not comparable or available for analysis.

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INSERT TABLES 6 AND 7 ABOUT HERE.

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Analyses of age and sex characteristics for the participating children were completed to investigate the homogeneity of the groups on these characteristics. Table 8 summarizes the age analysis and shows that there were no significant differences in age between the three groups. The χ^2 test, when applied to the distribution of s , did not identify any differences between the proportions of boys and girls in the study groups (χ^2 = 1.59, critical value of $\chi^2 = {}_{.05}\chi^2_{df=2} = 5.99$).

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INSERT TABLE 8 ABOUT HERE.

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Table 9 is a summary of group means for the variables analyzed and includes sample sizes and standard deviations for each data group.

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INSERT TABLE 9 ABOUT HERE.

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Conclusions

The design and statistical analyzes selected for this study provided both physical and statistical control of potential intervening variables. Several conclusions related to the dependent variables can thus be made.

Child progress in conceptual attainment was demonstrated through the computer-based curriculum developed from norm-referenced behavioral expectations. Concept mastery, as measured by the Boehm Test of Basic Concepts, was greater for children tutored from the computer-based behavioral curriculum than it was for those tutored from the paper copy behavioral curriculum or the paper copy conceptually-oriented curriculum. The other measures for child progress (Peabody Picture Vocabulary Test and Memphis Comprehensive Development Scale) did not identify any differences among the study groups.

Maternal interaction, as measured by the Maternal Teaching Style Research Instrument, was greater between mother and child for those tutored from the computer-based behavioral curriculum than it was for those tutored from the other tutoring modes.

Data management cost was represented by tutor and office staff time to prepare child progress and tracking information for computer storage and by tutor planning time to prepare for tutoring sessions. Altnough there were no differences in planning time between tutor groups, there was a difference in time as translated into a standardized dollar cost for preparing required data for computer storage. It was less expensive for the tutors to enter the data than to send raw data to office clerks for entry.

Although participating children were not randomly assigned, child-related intervening variables were statistically controlled by analysis of covariance (number of tutoring sessions and entering abilities and functional skills) and appraised by other analyses (age and sex). There were no indications of any systematic bias in child-related characteristics between the three groups.

What does all of this mean? Several hypotheses can be advanced from the results and conclusions of this study. The apparent advantages of the tutor-managed computer-based behavioral curriculum and child tracking system in conceptual attainment, mother-child interaction, and cost, may be attributable to more specific planning and immediacy of feedback profferred by the computer and its programs. Interestingly, the conceptually-oriented curriculum, which was designed specifically to help children master concepts subsumed within the Boehm Test of Basic Concepts, was no more effective in assisting conceptual attainment than the paper copy behavioral curriculum, which emphasized gross motor and fine motor skills in addition to concepts, and was less effective in concept attainment than the computer-based behavioral curriculum.

The computer-based behavioral curriculum appeared to be useful in maintaining a record of the performance and progress of students. It appeared to contribute

both to the better identification of relevant objectives for individual children and to their increased achievement. The curriculum also provided standard evaluation and observation criteria to measure student progress over the total program experiences.

A lack of significant differences among the Peabody Picture Vocabulary Test mean scores may be as attributable to the instrument as to the program. Although BTBC and PPVT were designed for non-readers, including young children, the PPVT seems to be more language-oriented and emphasizes nouns, whereas the BTBC places more emphasis on spatial concepts. It could be that the high-risk or handicapped children in this study were also language-deficient and were less able to comprehend nouns than they were able to understand concepts of position and direction.

Further research is needed to identify the characteristics of the tutor-managed computer-based behavioral curriculum that prompted the successes observed. Some emphasis should be given to the planning and feedback components of the system, and an analysis of the curricula to determine alternative hypotheses for the greater conceptual gain observed from the computer-based behaviorally-oriented curriculum should be included. Also, systematic validation of the MTSRI should be undertaken, and the mother-child relationship factors should be isolated for further study.

Finally, an exhaustive cost-effectiveness study is warranted based upon the findings of this study. This study only compared the efficiency of two procedures for entering data into the computer; the actual preparation of IEP's by tutor and computer should be compared to their preparation by tutor and staff, and the computer's success in recording, filing, and monitoring child tracking data specifically for IEP's should be closely investigated.

TABLE 1
Summary of Study Design

Independent Variable	Group A	Group B	Group C
Curriculum	Norm-referenced by age	Norm-referenced by age	Conceptually-oriented
Computer	Computer-based curriculum; Data managed by tutor and computer	Paper copy curriculum; Data managed by clerk and computer	Paper copy curriculum; Data managed by clerk

TABLE 2
Summary Table of ANCOVA for PPVT (Peabody Picture Vocabulary Test)

Source of Variance	df	Residuals ss	ms	F*
Between groups	2	486.942	243.471	1.94
Within groups	42	5269.727	125.470	
Total	44	5756.669		

* critical value of $F = {}_{.05}F_{2,90} = 3.232$

TABLE 3
Summary Table of ANCOVA for BTBC
(Boehm Test of Basic Concepts)

Source of Variance	Residuals			
	df	ss	ms	F*
Between groups	2	185.502	92.751	19.948
Within groups	42	195.288	4.650	
Total	44	308.790		

* critical value of F = $_{.05}F_{2,40}$ = 3.232

TABLE 4
Summary Table of ANCOVA for MCDS
(Memphis Comprehensive Developmental Scale)

Source of Variance	Residuals			
	df	ss	ms	F*
Between groups	2	13.474	6.737	.056
Within groups	42	5032.395	119.819	
Total	44	5045.868		

* critical value of F = $_{.05}F_{2,40}$ = 3.232

TABLE 5
Summary Table of ANCOVA for MTSRI
(Maternal Teaching Style Research Instrument)

Source of Variance	df	ss	ms	F*
		Residuals		
Between groups	2	622.016	311.008	11.852
Within groups	39	1023.449	26.242	
Total	41	1645.465		

* critical value of $F = {}_{.05}F_{2,39} = 3.316$

TABLE 6
Summary Table of ANOVA for Average Cost per Student for Data Management

Source of Variance	df	ss	ms	F*
Between groups	1	9.521	9.521	6.203
Within groups	28	42.990	1.535	
Total	29	52.510		

* critical value of $F = {}_{.05}F_{1,28} = 4.196$

TABLE 7

Summary Table of ANOVA for Average Planning Time per Student for Tutoring

Source of Variance	df	ss	ms	F*
Between groups	2	270.	135.	2.25
Within groups	12	720.	60.	
Total	14	990.		

* critical value of $F = {}_{.05}F_{2,12} = 3.89$

TABLE 8

Summary Table of ANOVA for Age of Participating Children

Source of Variance	df	ss	ms	F*
Between groups	2	0.25	.13	0.10
Within groups	128	172.13	1.34	
Total	130	172.38		

* critical value of $F = {}_{.05}F_{2,120} = 3.07$

TABLE 9

Summary of Group Means for Dependent Variables Showing Significant Group Differences, Sample Sizes, and Standard Deviations

Variable	Group A			Group B			Group C		
	n	$\bar{X}$	s.d.	n	$\bar{X}$	s.d.	n	$\bar{X}$	s.d.
Child Progress									
PPVT**	22	51.50	10.15	13	50.55	16.08	12	52.65	13.62
BTBC**	22	16.87*	2.57	13	14.84	4.39	12	15.08	4.30
MCDS**	17	47.10	17.36	10	47.17	9.21	11	45.69	5.25
Maternal Interaction									
MTSRI**	15	65.14*	13.18	13	49.04*	16.73	16	58.04*	10.81
Data Management Cost									
Cost per Student	15	1.80*	1.24	15	2.92*	1.24	-	-	-
Planning Time	5	22.00	4.47	5	31.00	8.94	5	31.00	8.94
Age of Children	32	3.02	1.18	21	3.14	0.95	27	3.08	1.24

* group mean is significantly different from other group means ($p < .05$).

** group means have been adjusted to compensate for differences between groups on the control measures.

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